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VIRUS DISEASE OF SOCKEYE SALMON

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INTRODUCTION

Kokanee and blueback salmon, members of the species Oncorhynchus nerka, recently suffered tremendous losses in several hatcheries in the State of Washington. Symptoms of a disease which occurred in some of these hatcheries during 1948 to 1950 suggest a possibility that there were sporadic outbreaks as early as 1948. Salmon nutrition studies are conducted at one of the hatcheries. An unexplained mortality in 1944 occurred among blueback salmon which were on an experimental diet of adult salmon viscera. Hemorrhagic areas were noted at the bases of fins, and though they were attributed to avitaminosis, they could not be reproduced. In retrospect this symptom might well indicate one of the first hatchery occurrences of sockeye virus disease. In 1951 the infection was recognized as a distinct entity and then described. The disease is unique in that present knowledge records its occurrence in hatcheries during a period of only a few years. It was not reported between 1954 and 1957, but a minor outbreak occurred early in 1958. Investigators who studied this disease strongly suspect that it is caused by a virus, but indicate at the same time that the critical proof for the viral character of this disease had not been secured as yet.

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IDENTIFICATION

Diseased fish are generally lethargic, but some individuals display sporadic hyperactivity. Abdominal swelling is evident, and hemorrhages occur at the base of fins or in the isthmus. Internally the spleen is often pale; the stomach is filled with a milky fluid, and the intestines inflamed and filled with watery, yellow colored fluid and at times blood also. Fish which survive the acute stages are often left with severe spinal deformities. There may be as many as 0.1 percent of the original number so affected.

CAUSE OF DISEASE

The etiologic agent of the disease is apparently not affected by sulfonamides or antibiotics. It will pass through at least one type of filter which retains bacteria. Inocula become impotent if heated to about 60° C for short periods. The disease can be reproduced in susceptible fish and repeatedly transferred. These and other characteristics denote the virus nature of the agent which is probably the cause of the disease.

SOURCE AND RESERVOIR OF INFECTION

The source of hatchery infection was demonstrated with reasonable certainty to be

fresh-frozen eggs and viscera employed in the diet of the infected young fish. This was confirmed by demonstrating that a similar if not identical disease could be produced by a filterable agent, present in livers of some returning adult salmon.

MODE OF TRANSMISSION

Without doubt the primary infections observed in hatcheries have resulted from feeding of infected material. Contact transmission from diseased to healthy fingerlings probably also occurs. Circumstantial evidence of at least one epizootic strongly suggests that spread within the hatchery was effected by contaminated cleaning and feeding equipment. Attempts to effect experimental transmission with such equipment were not successful. The maintenance of this disease in nature may involve contact, vector, or egg transmission.

INCUBATION PERIOD

Under experimental conditions infections were transmitted from diseased to healthy fingerlings in about 12 days. Parenteral inoculations required from 1 to 45 days to produce disease symptoms depending upon the titer (relative virulence) of the inoculum and the route by which it was administered.

PERIOD OF COMMUNICABILITY

Most occurrences within hatcheries have involved fish 5 to 6 months old. Experimentally fish as young as 2 months or as old as 14 months could be infected. The latter is beyond the age Pacific salmon are usually held before being released. Beyond the first year of life little is known of the disease process except that it is apparently carried in some returning adults.

SUSCEPTIBILITY AND RESISTANCE

The disease has thus far occurred only in kokanee and blueback salmon (O. nerka). Of these two, higher mortalities have occurred in the sockeye. Silver and chinook salmon, suckers, rainbow and cutthroat trout were refractory to experimental infection.

RANGE

Thus far the reported hatchery epizootics have all occurred within the State of Washington. It is entirely possible that the disease could occur anywhere within the vast Columbia River watershed. Water temperatures have ranged from 45° F to 53° F; they have been static, rising and falling during different outbreaks. Under experimental conditions temperatures of 40° F to 60° F have greatly favored virulence of the disease, but fish held at 68° F had a significantly reduced mortality.

OCCURRENCE

Late spring to early summer has been the season during which outbreaks have thus far occurred. It is possible that this "season of occurrence" is not real, but that it is a result of fish age and hatchery practice, i.e., when eggs hatched, how soon feeding began, and probably most important, when pablum-like foods are stopped and a coarser (containing fish products) diet fed.

METHODS OF CONTROL

The occurrence of this disease has stopped with cessation of feeding raw salmon viscera. The promise of disastrous losses far outweighs the excellent food value of cheap raw salmon viscera, and in the light of present knowledge the disease can best be controlled by not feeding such material. Thorough sterilization of such food reduces its nutritive value, but it also kills all pathogens. If raw salmon viscera are not fed, it is unlikely that the disease will recur as commonly as it once did. As with any infection, this disease is part of nature and will in all probability remain as a heritage of O. nerka. When a new outbreak occurs affected troughs should be rigidly quarantined to prevent spread. In view of its high infectivity and subsequent mortality it would be best to kill all fish in such troughs and thoroughly sterilize fish, troughs and equipment used therein. Unaffected troughs should be carefully observed to determine if spread occurs and to attempt to check it if it does. Rigid sanitation should be practiced: equipment and hands and arms should not move from trough to trough without disinfection.

ANNOTATED BIBLIOGRAPHY

*Rucker, R. R., W.J. Whipple, J.R. Parvin, and C.A. Evans
1953. A contagious disease of salmon possibly of virus origin. U.S.D.I., Fish and Wildlife Service Fishery Bulletin 76, Vol. 54, pp. 35-46, illus.
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*Snieszko, S. F.
1953. Virus diseases in fishes: Outlook for their treatment and prevention. Prog. Fish-Cult., Vol. 15, No. 2, pp. 72-74.
The nature, biology and challenge of viruses as causes of disease are discussed in general easy-to-understand terms. From the general, the author moves to the particular - virus diseases in fishes. Problems which fish viruses present in research and fish culture are indicated. Six recommendations are enumerated for control of virus caused diseases.

Watson, M. E., R.W. Guenther, and R.D. Royce
1956. Hematology of healthy and virus-diseased sockeye salmon, Onchorhynchus nerka. Zoologica, Vol. 41, Part 1, pp. 27-38, illus.
Blood from healthy and diseased salmon was examined with phase contrast microscopy. Leucocytes and thrombocytes of diseased fry showed degeneration before mortalities began. Hematocrit showed an initial slight rise followed by a drastic drop then gradual return to normal. Excellent descriptions and illustrations.

*Watson, Stanley W., R.W. Guenther, and R. R. Rucker
1954. Virus disease of sockeye salmon: Interim report. U.S.D.I., Fish and Wildlife Service Spec. Sci. Rpt.--Fisheries No. 138, 36 pp.
Detailed report of an extensive investigation of the natural occurrences of this disease. Experimental transmissions were effected. Biological and environmental factors are reported. This is the most complete report as yet published.

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(pp. 335-339) Characteristics of several occurrences of this disease are summarized. Symptoms are described, and generalized methods of controlling virus diseases in fishes are included.

Wood, E.M., and W.T. Yasutake
1956. Histopathologic changes of a virus-like disease of sockeye salmon. Trans. Am. Micro. Soc., Vol. 75, No. 1, pp. 85-90, illus.
Detailed findings of a histopathological examination of sockeye salmon afflicted with what is considered to be a virus disease. Microscopic lesions were observed in several tissues. Pathogens were not observed, but neither were inclusion bodies, objects commonly associated with virus infections.

* Papers indicated by an asterisk are of special importance to fish-culturists.

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